RESPONSE TO COMMENTS
for
Microchip Technology Incorporated
(WA-0039578)
November 2004

A Draft National Pollutant Discharge Elimination System (NPDES) permit to Microchip Technology Incorporated was issued for public notice on October 25, 2002 in the Tacoma Tribune. The original public notice was to expire on November 25, 2002 (30 days). This comment period was extended in the same newspaper and finally expired on December 26, 2002. Comments were received by Microchip Technology Inc., Sylvia and Kenneth Retherford, and Lisa Lawrence of Citizens for a Healthy Bay.

This Response To Comments document is a summary of the significant comments related to the Microchip draft permit and the EPA's responses. This document also summarizes those changes made to the final permit based on the Puyallup Tribe's final 401 certification (See Appendix A). The October 25, 2002 Fact Sheet was a final document, therefore comments received on the Fact Sheet have been addressed in this document as they relate to the final permit language/conditions. The section of the final permit that the comment refers to has been provided in parentheses after the comment when possible.

Facility is Currently for Sale

1. **Comment (Microchip):** The Puyallup Fab 3 facility is currently being held for sale by Microchip.

Response: All references to Microchip in the final permit except for the cover page have been replaced with "the permittee" so that if/when a sale occurs, a name change could more easily be accommodated.

Administrative Changes

2. **Comment (Microchip):** The facility street address should read "1111 - 39th Avenue S.E." (Title Page).

Response: The final permit has incorporated the corrected facility address.

3. **Comment (Microchip):** Since "mean cell residence time" is a calculated number, it should be moved below "total toxic organics" in Table 1 so the monitoring limits are all listed together. (Section I.A, Table 1)

Response: The EPA agrees and has made the change to the final permit

4. **Comment (Microchip):** Delete "A copy shall be sent to the Puyallup Tribe's Environmental Protection Department upon completion" as it is redundant with Section II.A.1 (Section II.A.5).

   Response: The EPA agrees and has removed this sentence from Section II.A.5.

5. **Comment (Microchip):** Microchip requests that the DMR reports be postmarked the "last" day of the month and not the 10th day of the month. (Section II.E)

Response: In order to electronically track whether or not a DMR is submitted in a timely manner an actual day needs to be entered into EPA's database (called the Permits Compliance System or PCS). Because the system can not calculate the "last" day of each of the calendar months, the 28th day was used in the final permit instead of the 10th day. This change fulfills the intent of Microchip's request to provide additional time to submit reporting data.

6. **Comment (Microchip):** The MDR system with its on-line monitoring is an important component of the WWTP improvements. Although the provision in the permit relating to additional monitoring is boilerplate and cannot be clarified in the permit itself, the following statement should be included in the fact sheet and transmittal letter for clarification: "Additional in-line and process control monitoring are not intended for the calculation and reporting of compliance with effluent limitations on the monthly discharge monitoring reports (DMRs)." Otherwise, there is a disincentive and potential penalty for implementing the MDR system to prevent noncompliance. (Section II.F)

Response: Section II.F ("Additional Monitoring by the Permittee") of the permit contains the following requirement: "If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased frequency shall also be indicated and an explanation of why such additional monitoring was performed."

The fact sheet is a final document that was developed to support the conditions of the draft permit and can not be modified. However, the final permit transmittal letter to the facility will contain the above requested statement. Although in-line monitoring is not used to determine compliance with effluent limits it shall be submitted to EPA, the Tribe, or Ecology upon request for permit reissuance purposes.

7. **Comment (Microchip):** Please confirm or add to the Definition section that "Treatment works" means "Publically Owned Treatment Works (POTW)" (Section II.K.1)

Response: The EPA realized from this comment that Section II.K of the draft permit contains regulatory boilerplate intended for POTWs only (See 40 CFR 122.42.b) and that the following boilerplate is necessary (and has been added to the final permit) for manufacturing, commercial, mining and silvicultural discharges (40 CFR 122.42.a). The definition of treatment works is not in the final permit and therefore has not been added to the definitions section the of the final permit.

"K. **Changes in Discharge of Toxic Substances**. The permittee must notify the Director and the Puyallup Tribe's Environmental Protection Department as soon as it knows, or has reason to believe:

1. That any activity has occurred or will occur that would result in the discharge, on a routine or frequent basis, of any toxic pollutant that is not limited in the permit, if that discharge may reasonably be expected to exceed the highest of the following "notification levels":

   a. One hundred micrograms per liter (100 µg/l);

   b. Two hundred micrograms per liter (200 µg/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 µg/l) for 2,4-dinitrophenol and for 2-methyl-4, 6-dinitrophenol; and one milligram per liter (1 mg/l) for antimony;

   c. Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7); or

   d. The level established by the Director in accordance with 40 CFR 122.44(f).

2. That any activity has occurred or will occur that would result in any discharge, on a non-routine or infrequent basis, of any toxic pollutant that is not limited in the permit, if that discharge may reasonably be expected to exceed the highest of the following "notification levels":

   a. Five hundred micrograms per liter (500 µg/l);

   b. One milligram per liter (1 mg/l) for antimony;

   c. Ten (10) times the maximum concentration value reported for that

pollutant in the permit application in accordance with 40 CFR 122.21(g)(7); or

d. The level established by the Director in accordance with 40 CFR 122.44(f)."

8. **Comment (Microchip):** Add a phrase to Section III.E.4 that the pollution prevention plans for arsenic and mercury "may be a part of the Wastewater Treatment System Operation Plan." This statement is consistent with Section III.E.1 that states that all plans can be consolidated in one operating plan.

Response: in response to this comment the EPA has added the following sentence (in bolded text below) to paragraph two of Section III.E.4 of the permit. "Microchip will also develop Pollution Prevention Plans for Arsenic and Mercury to control the discharge of these two metals and a Solvent Management Plan for the control of Total Toxic Organic Compounds. These plans shall be submitted to the Tribe's Environmental Protection Department by 18 months from the effective date of the permit and approved by the Tribe prior to implementation. **These plans may be a part of the WWTSOP**. The substitution of reagent grade chemicals for technical grade chemicals are approved for implementation on the effective date of the permit."

9. **Comment (Microchip):** Please delete the text after the first sentence of Section III.E.5 of the permit. The plant has already been designed through an approved facilities plan (October 2001) to handle more than the permitted flow (i.e. up to 3 mgd).

Response: The EPA agrees that Section III.E.5 as it appeared in the draft permit is unnecessary. However, the Puyallup Tribe requested in its 401 certification (see Appendix A) that additional operations and maintenance conditions be added to the final permit, and these were placed in section III.E.5. This section now reads:

"5. All known, available and reasonable methods of prevention, control and treatment (AKART) shall be used to reduce arsenic concentrations in all batch and continuous wastewater discharges. AKART shall include an arsenic source control program, which includes procuring commercially available non-process chemicals with the lowest possible concentrations of arsenic.

a) For batch discharges, AKART shall also include:

i) The best available adsorption technology to reduce arsenic concentrations in non-process wastewater prior to discharge. Microchip will provide certification that the chosen technology meets the AKART standard.

ii) If arsenic concentrations can be further reduced, fine filtration, in addition to adsorption, will be used to treat non-process wastewater prior to discharge to the Puyallup River. Effective immediately, Microchip will carry out pilot testing of 1, 5, and 10-micron filtration technology to evaluate whether additional reduction of arsenic concentrations in the non-process waste stream can be achieved. Testing results, including raw data and evaluation techniques will be made fully available to the Tribe.

b) For continuous discharges, AKART shall also include:

i) a granular activated carbon system and fine filtration to reduce arsenic concentrations of non-process wastewater prior to discharge to the Puyallup River. Microchip will provide certification that the chosen technology meets the AKART standard."

16. **Comment (Microchip):** Please revise or make clear in the record that "filter backwash" means "filter backwash solids" because only the solids, not the water, are removed substances. (Section III.F).

Response: Section III.F - Removed Substances of the draft permit read "Collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.."

The intent of this regulatory language is to prevent collected solids from reentering waters of the United States. Therefore, the language has been modified to read in the final permit "Solids, sludges, or other pollutants removed in the course of treatment or control of water and wastewaters must be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters."

17. **Comment (Microchip):** A definition should be added for "start of wafer production." The following definition is suggested "Start of wafer production means the first date that the permittee issues the first lot of wafers after completion of tool and process qualifications." (Section V)

Response: The above suggested definition has been added to Section V.19 of the final permit.

18. **Comment (Microchip):** Table 1 of the fact sheet should be titled "MASCA Effluent Violations, Jan. '96 to Dec. 01" The non-compliance is not attributed to Microchip's ownership and operation.

Response: The Fact Sheet is a final document and cannot be changed. However the text prior to Table 1 in the fact sheet implies that the compliance violations occurred during MASCA's ownership and that EPA issued an administrative order in response to these violations.

Ammonia Limits

19. Comment (Microchip): The ammonia limits included in the draft permit use MASCA's previous historical effluent data. The average monthly limit (AML) should be recalculated based on the expected improvements to the plant that were contained in the approved Engineering Design Plans (i.e. Engineering Report) and permit renewal application. The upgraded facility is designed to treat to 6 mg/L NH_3 and therefore an AML of not less than 9 mg/L should be included to allow for a margin of safety. This suggested limit represents a decrease in loading from the previous permit and doesn't rely on using any of the total maximum daily load (TMDL) reserve. In addition, the previous maximum daily limit (MDL) of 30 mg/L should be retained in the reissued permit.

In addition, downstream data from the Washington State Department of Ecology (Ecology) water quality monitoring (station #10A050) should be used to determine the ammonia criteria. (Section I.A, Table 1)

Response: Actual effluent data (from past discharge monitoring reports) is generally used when determining whether or not there is the reasonable potential for the discharge to violate approved water quality standards. Although engineering design plans are a good indication of what changes can be expected in the future, they are not enforceable documents, can change, and may not accurately represent actual operating effluent concentrations.

If the reasonable potential is found, then EPA develops effluent limits that are protective of the designated uses of the receiving water. In general, the CWA requires that the effluent limits for a particular pollutant be the more stringent of either technology-based or water quality-based limits. Additionally, the Puyallup Tribe's water quality standards also consider the facility's current performance. In the case of ammonia, there are not technology-based limits for ammonia (40 CFR 469.14 & 15) and therefore the most stringent limits are water quality-based. These limits are not based on what the facility can achieve (as determined by engineering reports) and can not modified to allow a margin of safety for compliance purposes. These requirements are consistent with the NPDES regulations found at 40 CFR 122.44 and EPA's Technical Support Document (TSD). The maximum daily and average monthly limits are developed using the statistical analyses found in the TSD. These are based on data variability, available dilution and approved water quality standards.

EPA does agree that using the downstream suggested station will result in the most accurate ammonia water quality criteria. The tribe's ammonia water quality criteria is expressed as a formula dependant on pH and temperature. Therefore, consistent with Region 10's policy, EPA used the 95th percentile of the available pH and temperature data from the suggested downstream monitoring station from 1981 to the present to determine the ammonia criteria. The data set used is more robust than suggested by Microchip (i.e., includes data from 1981 to 1994 collected by the United States Geological Survey and from October 2001 to September 2002). Because the toxicity of ammonia increases with increasing temperature and pH, and there was a slight increase in pH and temperature using the new data set, the water quality criteria increased slightly as provided in Table 1.

Table 1: Water Quality Criteria for Ammonia

Draft Permit (pH = 7.9, T = 15.7 °C)		Final Permit (pH = 7.7, T = 15.5 °C)	
Acute	1.5 mg/L	Acute	2.0 mg/L
Chronic	6.7 mg/L	Chronic	9.3 mg/L

In order to determine whether or not there is the reasonable potential to exceed the criteria, a maximum effluent concentration at the edge of the mixing zone was determined using a maximum effluent value adjusted for effluent variability and dilution. The draft permit utilized the effluent monitoring data from past discharge monitoring reports (DMRs) to conduct the reasonable potential analysis. Microchip's permit application provided a maximum effluent concentration of 9.5 mg/L (based on a 95% confidence level of the effluent data since the new wastewater treatment plant went online in January of 1998. See email from Mari Chesser dated 12/5/02). EPA's guidance does not recommend the use of the 95% confidence level of effluent data, or the design criteria of any treatment system to determine the maximum expected effluent concentration. However, EPA agrees that the reasonable potential calculations should reflect the effluent quality since the new treatment plant went online. Therefore, EPA has reviewed the available effluent data from January 1998 through June 2003 (45 data points) and utilized the maximum concentration of 7.9 mg/L in the reasonable potential analysis and determined that effluent limits are still necessary[1] . These calculations are provided in Appendix B of this response to comments document.

[1]Microchip has stated that the 35 mg/L maximum daily ammonia concentration reported in September of 1998 was an anomaly caused by the shutdown of the plant. EPA conducted a statistical evaluation of the September 1998 data point and a October 1999 concentration of 39 mg/L, and concluded that these two data points are in fact, outliers. Therefore, these concentrations were not considered in the reasonable potential analysis.

Revised water quality-based effluent limits for ammonia were calculated using the recalculated water quality criteria (in Table 1) and the variability of the data observed since January of 1998. These limits are provided in Table 2.

Table 2: Water Quality-Based Effluent Limits for Ammonia	
Maximum Daily Limit (MDL)	17 mg/L (250 lb/day)
Average Monthly Limit (AML)	5.7 mg/L (89 lb/day)

In addition to the water quality-based determination, EPA utilized the approved Washington Department of Ecology (Ecology) total maximum daily load (TMDL) analysis. The use of the TMDL is consistent with the regulatory requirement (found at 40 CFR 122.44(d)(1)((vii)(B)) which requires that effluent limits be consistent with the assumptions and requirements of any available wasteload allocation approved by EPA. The TMDL concluded that additional ammonia (and biochemical oxygen demand) limits are necessary to restore the designated uses of the Puyallup River including the protection of aquatic life. The TMDL was developed in response to the impairment (i.e, 303(d) listing) of the Puyallup River. The TMDL provided a waste load allocation (WLA) to the Microchip facility of 240 lbs/day of ammonia. At the permitted effluent flow rate of 1.88 mgd, this results in a maximum daily concentration limit of 15.3 mg/L. This MDL is more stringent than the water quality-based limit found in Table 2 and has therefore been included in the final permit. The inclusion of this more stringent limit is based on EPA regulations found at 40 CFR 122.44(d).

In summary, the final permit includes an AML from the water quality-based calculations, and a MDL based on the facility's WLA from the TMDL.

Table 3: Final Permit Effluent Limits for Ammonia	
Maximum Daily Limit	15.3 mg/L (240 lb/day)
Average Monthly Limit	5.7 mg/L (89 lb/day)

Arsenic Limits

20. Comment (Microchip): The arsenic limits should be revised so that the effluent limits do not automatically put the facility out of compliance.

(Microchip, 3/22/04): A 0.68 ug/L limit is not consistently attainable using best available technology.

Response: Consistent with the NPDES regulations found at 40 CFR 122.44(d)(1)(iii), when the permitting authority determines that a discharge has the reasonable potential to cause, or contribute to an in-stream excursion above the allowable ambient concentration of a State (or Tribal) water quality standard, the permit must contain effluent limits for that parameter. The water quality-based effluent limits shall ensure that the level of water quality to be achieved by limits complies with all applicable water quality standards (40 CFR 122.44(d)(1)(vii)(A)). These regulations do not provide provisions for establishing limits based on what the facility can comply with. See also response to comment #3 above.

21. **Comment (Microchip):** EPA should include an AML of 2.8 µg/L and MDL of 4.9 µg/L as effluent limits in the final permit. The draft arsenic limits are inconsistent with the approved Engineering Report.

(Microchip, 3/22/04): The TSD requires EPA to consider "whether technology-based limits are sufficient to maintain water quality standards." The Tribe's 401 certification has made this determination.

Response: While the basis for the suggested limits is not identified, it appears that the Commenter is proposing limits based on the Microchip Engineering Report, which estimates what the facility can achieve. NPDES permits must contain the more stringent of technology and water quality-based effluent limits when there is the reasonable potential to violate water quality criteria. The effluent limitation guidelines for semi-conductor manufacturing facilities (40 CFR 469.14 & 15) do not include technology-based limits for arsenic, therefore they are not protective of the Tribe's water quality standards for arsenic. However, because EPA determined that there is reasonable potential to exceed the water quality standard, effluent limits need to be developed that are protective of the Tribe's approved water quality standards. The procedure that EPA uses to develop water quality-based limits is found in the TSD. EPA does not believe that the Tribe's 401 certification suggests that water quality-based limits are not necessary. See also response to comment #20 above.

22. **Comment (Microchip):** The arsenic in Microchip's effluent is from the influent process water and not process chemicals.

(Microchip, 3/22/04): If Microchip added no arsenic to the wastewater, sampling could still produce arsenic results of greater than 0.68 ug/L. This would make the facility's compliance a function of natural river conditions, not control of its operations.

Response: The fact that the influent (i.e., process) water that Microchip uses contains arsenic, does not eliminate the need for effluent limits that protect the designated uses of

the Puyallup River. It is EPA's understanding that the process water used is from the Green River not from the receiving waters (i.e., Puyallup River). EPA has not been provided with Green River arsenic data and therefore cannot confirm or deny the concentrations of arsenic in Microchip's intake water. Regardless, credits or adjustments for pollutants found in intake water are not available for water quality-based effluent limits. These credits can be available when compliance with technology-based limits can not be achieved but the intake water must be the same as the receiving water. See 40 CFR 122.45(g).

The EPA is not sure where the arsenic in Microchip's effluent is coming from. The concentration of arsenic in the facility's effluent appears to exceed the ambient concentration of arsenic upstream of the outfall in the Puyallup River (See Appendix C for data summary). The EPA has determined that the discharge of arsenic from this facility has the reasonable potential to cause or contribute to an exceedence of the tribal water quality standard and therefore an effluent limit for arsenic is required.

23. **Comment (Microchip)**: The Ecology's TMDL program is considering delisting the Puyallup River for arsenic

Response: The need for arsenic limits is not affected by whether the River is impaired for arsenic. The designated uses of the river need to be protected and permit limitations must be included sufficient to achieve the Tribe's applicable water quality standards (Section 301(b)(1)(C))[2]. The need for effluent limitations in the permit is based on the ambient arsenic concentration in the river, irrespective of the river's status on a 303(d) list.

24. Comment (Microchip): The last four years of data from Microchip and MASCA do not show variation in the effluent concentration nor has it caused toxic conditions through the whole effluent toxicity (WET) testing.

Response: The Commenter seems to be arguing that because previous WET test results do not demonstrate toxicity, parameter specific limits for arsenic are not necessary. This assumption is incorrect. Whole effluent toxicity testing was conducted on water fleas and fathead minnows and while the results are a good indicator of the aggregate effects of the effluent on aquatic life, they do not demonstrate protection of human health. The human health criteria for arsenic is more stringent than the aquatic life criteria and therefore WET test results do not obviate the need for arsenic limits. Section 3.1.2 of the TSD states ""..there are two possible approaches to characterizing effluents for human

[2]The Puyallup River (Segment WA-10-1020) is currently listed as impaired for arsenic and requires a TMDL (See 1998 303(d) list).

health effects; chemical-by-chemical and whole effluent. However, only the chemical-by-chemical approach currently is practical for assessing and controlling human health impacts."

25. **Comment (Microchip, 3/22/04):** EPA's current approach does not reflect the significant natural variability in the fresh water intake or the receiving water. The Puyallup River can vary from 0.5 ug/L to more than 1.0 ug/L. This variability is not seasonal or consistent. This results in limits what would likely be exceeded in excess of 50% of the time.

Response: The commenter appears to be suggesting that net credits (i.e., intake credits) are appropriate when determining the need for arsenic limits. However, intake credits are only available when compliance with the technology-based limits is difficult or impossible to meet with technology (40 CFR 122.45(g)). As stated in the Response to comment #21 above, the technology-based limits for semi-conductor manufacturing facilities (40 CFR 469.14 & 15) do not include technology-based limits for arsenic (only TTOs, Fluoride, and pH) and the final limits in the permits are water quality-based. In addition, the regulations require that the intake water must be taken from the same body of water into which the discharge is made. Microchip uses intake water from the Green River and discharges to the Puyallup River.

In addition, the variability of arsenic in the Puyallup River does not affect the effluent limits in terms of providing tiered limits because a mixing zone has not been provided for arsenic. Mixing zones (i.e., areas of dilution) are only available when the background concentrations are less than the water quality criteria for that same pollutant. Because a mixing zone is not available for arsenic, the effluent limits have been developed to protect the Puyallup River prior to discharge into the river. The arsenic in the Puyallup River was considered in response to comment #29 regarding natural background.

The NPDES permit program does not place requirements or regulate what intake water is used by a facility, the program only regulates the quality of the effluent to assure that the designated uses of the River are protected.

26. **Comment (Microchip, 3/22/04)**: EPA's current evaluation isn't using monitoring that is representative of current (September 2003) installed technology controls. EPA is "required to consider, at a minimum, the existing controls."

EPA is not using models to conduct reasonable potential analyses or develop effluent limits that are found in EPA's regulations or guidance documents (i.e. Permit Writer's Manual or TSD). There is not a clear and logical rationale for rejecting this guidance.

Response: The permit application provided by Microchip requests a production-based permit. EPA is aware that improvements have been made to the facility that have resulted in reduced arsenic in the effluent. EPA is not aware of specifically what actions have taken place in September 2003 to limit arsenic, nor was this information provided in the comments. EPA understands from the August 2003 Interim Startup and Operation Activities document that Microchip has committed to 1) develop an arsenic source control program; 2) implement best available adsorption technology to reduce arsenic concentrations; and 3) if arsenic concentrations can be further reduced, install and implement fine filtration. Based on Microchip's 3/22/04 comments, EPA understands that the treatment chemicals used in the boiler and cooling tower have the lowest possible arsenic concentrations (less than 5 µg/L). Microchip's 3/22/04 comments further state that the adsorption technology has not been installed yet.

The EPA acknowledges these improvements, however, the facility has not been operating since Microchip purchased the facility on July 26, 2000 and therefore current monitoring data is not representative of operating conditions. During wafer production, the plant generates eight different process treatment trains and treats five different wastewaters. While the facility is idle only the neutralization treatment train is operating in batch mode. This train includes cooling tower blowdown, boiler water blowdown and rainwater. Until EPA is provided with effluent data that accurately represents the quality of the discharge during production, we must rely on the more robust data set (from February 1998 through 2004). In response to Microchip's comment, a reasonable potential analysis was conducted (See Appendix C) using the three data points that have been collected since September 2003. This analysis concluded that the maximum expected effluent concentration is approximately 23 times greater than the human health criterion (based on natural background). Therefore effluent limits for arsenic are still needed to protect for human health using the limited data since September 2003.

EPA is using the reasonable potential analysis suggested by the TSD. When water quality-based limits were determined to be necessary for arsenic, EPA used the permit limit derivations recommended by the TSD to develop those limits. See Appendix C for arsenic calculations.

27. **Comment (Microchip, 3/22/04):** Since the objective of the permit is the protection of the Puyallup River, EPA should evaluate the quality and characteristics of the combined discharge from the City of Puyallup and Microchip rather than just the discharge from Microchip's plant. EPA is required to consider the effect of "multiple discharges" in the same pipe on the receiving waters. This is consistent with the approach taken during consultation with the National Marine Fisheries Service. This would result in values, during batch discharge, that are less than the human health criterion. [calculations were provided]

Section 6.3.1 of the Permit Writers Manual states "When conducting an effluent characterization to determine if WQBELs are needed based on chemical specific numeric criteria in the water quality standards, the permit writer projects the receiving water concentration of pollutants contained in the effluent *once that effluent enters the receiving water*."

Response: At the request of the permittee, the final permit is a process-based permit. The conditions of the permit (effluent limits included) protect the receiving water up to flows of 1.88 mgd, as well as lesser batch discharge flow from 3-5 gallons per minute. Therefore a reasonable potential analysis must protect the Puyallup River at the 1.88 mgd flow.

This reasonable potential analysis can not include the influences from City of Puyallup's effluent because Microchip does not have authority, or responsibility, for the City's effluent quality or flow volume. EPA agrees that multiple discharges must be taken into account when developing a mixing zone (if one is available) such that more dilution is not provided than is available. However, because the background concentrations of arsenic are not less than the water quality criteria, dilution is not available.

EPA consultation with the National Marine Fisheries Service on the Microchip permit did not consider the concentration of pollutants from the City where mixing zones were not available. The consultation included modeling for ammonia, chlorine and mercury (not arsenic).

The Permit Writers Manual does not specifically state what would should occur if dilution is not available in the quoted sentence. In fact, the mass balance equation provided in the example on page 102 only includes the condition where dilution is available. This example states that the *available* dilution from upstream river flow is 1.2 cfs. It intuitively makes sense that you can not use upstream river flow that contains concentrations of arsenic that barely meet or exceed the human health criterion to dilute effluent containing that same pollutant. Mixing zones (i.e., areas of dilution) are further not utilized by EPA unless they are provided in the Tribe's 401 certification. A mixing zone was not provided, or available, for arsenic.

28. **Comment (Microchip, 3/22/04):** It appears that EPA is not approaching arsenic in a manner that is consistent with other permits, such as the City of Puyallup. The City's permit provides mixing zones for parameters limited by an impaired water body.

Response: EPA consistently provides water quality-based permit limits in permits for all of those parameters that have the reasonable potential to violate tribal/state water quality standards. The EPA disagrees that the Tribe provided a mixing zone to the City, when dilution was not available. Mixing zones were provided to the City by the Puyallup Tribe for copper, lead, mercury, zinc, pH and ammonia. The Puyallup River is not 303(d)

listed for any of these parameters (although a preventative TMDL exists for ammonia) and Appendix C of the City's Fact Sheet determines that the background values of these pollutants are less than the Tribe's criteria for those same pollutants.

29. **Comment (Microchip)**: EPA should consider the tribe's antidegradation water quality standard at Section 8, which states "whenever the natural conditions of said waters are of a lower quality than the criteria assigned, the natural conditions shall constitute the water quality criteria." (Section I.A, Table 1).

(Microchip, 3/22/04) EPA should consider the variability of arsenic in the Puyallup River and Green River when developing the water quality criterion. The levels in the Puyallup River can vary from 0.5 ug/L to more than 1.0 ug/L and do not show a specific seasonal or consistent monthly pattern. Section 3.1.3 of the TSD requires EPA to consider these "other important factors."

Response: In response to this comment, EPA considered the tribe's antidegradation standard to determine if water quality criteria based on natural background should be used to determine the effluent limits for arsenic. Section 8(2) of the Tribe's standards state:

> "Whenever the natural conditions of said waters are of a lower quality than the criteria assigned, the natural conditions shall constitute the water quality criteria."

The tribe has acknowledged in their final 401 certification that EPA's use of the natural condition provision in its antidegradation standard is appropriate because there are natural background levels of arsenic in the Puyallup River. Natural background in the Green River is irrelevant because the discharge is ultimately to the Puyallup River. The Tribe is currently conducting an arsenic study in the Puyallup basin to better determine "natural background" (see Appendix A for copy of final 401 certification). Upon completion of the study, the permit can be modified to more accurately reflect the natural background concentrations of arsenic.

Until the study is complete, EPA considered the best available data to determine an average upstream natural background value of arsenic of 0.68 µg/L. EPA used ambient upstream data from the report titled "Results and Recommendations from Monitoring Arsenic Levels in 303(d) Listed Rivers in Washington." This data represents the surface water quality present before any human-caused pollution. Although Region 10 uses the 95th percentile data to calculate background concentrations for use in reasonable potential analyses, this percentile is not protective when applied to interpreting water quality criteria, especially human health criteria. Because human health criteria is based on exposure to long term concentrations, the use of an average value is a reasonable approach. Section 5.4.4 of EPA's TSD states that "Developing permit limits for pollutants affecting human health is somewhat different from setting limits for other

pollutants because the exposure period is generally longer than one month...." Although Microchip's biological evaluation (BE) states that the fish migrate through the Puyallup River, implying that they reside in the river less than one month, very limited data is available to confirm this. Therefore, an average value reasonably represents the entire available data set and the 0.68 µg/L value replaces the human health criteria in accordance with the Tribe's standard. See Appendix C for more details.

The permit regulation at 40 CFR 122.44(d)(ii) requires regulatory authorities to consider the variability of the pollutant or pollutant parameter in the effluent when determining the need for effluent limits. EPA uses this variability (i.e., coefficient of variation) in the reasonable potential analysis to determine a reasonable potential multiplier. This regulation does not state or imply that effluent variability should be used to determine new water quality criterion (based on natural background).

EPA evaluated the reasonable potential for the concentration of arsenic in the effluent to exceed both the aquatic life criterion and the new human health (natural condition) criteria. A mixing zone (i.e, area of dilution) is not available when determining reasonable potential for the protection of human health because the background concentration of arsenic is not better than the human health criteria. Because there is the reasonable potential to exceed the human health criteria based on natural conditions, effluent limits are necessary in the final permit. Table 4 presents the revised final effluent limits.

Table 4: Final Permit Effluent Limits for Arsenic	
Maximum Daily Limit, inorganic	1.8 µg/L (lb/day)
Average Monthly Limit, inorganic	0.68 µg/L (lb/day)

30. **Comment (Microchip, 3/22/04):** EPA should defer the setting of arsenic limits until the Tribe completes its field monitoring for natural background.

Response: The NPDES regulations require that water quality-based limits be included in permits when there is the reasonable potential to violate the Tribe's water quality standards. See responses to comments #20 and 21 above. The EPA has made the best determination of natural background as is possible given the available information. This natural background determination has resulted in arsenic limits that are less stringent than those based solely on the tribe's approved human health criteria (See proposed arsenic limits in the draft permit and fact sheet). The Tribe submitted the results of the Puyallup Basin Phase II Metals study to EPA on October 26, 2004. The results are consistent with the permit limits of 0.68 ug/L. The Tribes final 401 certification, Dated November 2004 deems the final arsenic limits consistent with the tribes water quality standards and have been retained in the final permit.

WET Testing

31. **Comment (Microchip):** The section on WET testing should be clarified to state that culture water may be laboratory or receiving water, and that the dilution and control water shall be the same kind of water and may be either laboratory or receiving water. Microchip will conduct parallel WET testing (i.e., using receiving water and laboratory water) but only the laboratory water tests will be reported on the discharge monitoring reports (DMRs.) (Section I.C.2.c.i)

Response: The EPA agrees that laboratory water can be used for WET testing and has modified Section I.C.2.c.i as follows:

"Control and dilution water can be laboratory water for the purposes of DMR reporting. If the dilution water used is different from the culture water, a second control, using culture water shall also be used. In no case shall water that has not met test acceptability criteria be used as dilution water."

The permittee has agreed to conduct concurrent WET testing using receiving waters. For purposes of this paragraph, "receiving water" means water collected from the Puyallup River upstream from the permittee's discharge. These results shall be submitted to the Puyallup Tribe's Environmental Protection Department."

Effective Dates in the Permit

32. **Comment (Microchip):** Many of the date lines in the permit are for a certain number of months after the permit is issued, but are actually relevant to a period of time after the production process begins. Please revise to read "within 90 days of the start of wafer production or 3 years from the effective date of the permit." (Section I.C.4)

Response: This permit is a unique case because the facility is not currently in production and yet is still operating and discharging in maintenance mode. Section I.C.4 has been modified to read "The permittee shall develop and submit to EPA an initial investigation Toxicity Reduction Evaluation (TRE) workplan within **90 days of the start of wafer production or three years from the effective date of this permit, whichever is sooner**." This language assures that activities are conducted during the five year effective period of the permit and yet provides the facility time to determine appropriate production activities.

33. **Comment (Microchip):** Please revise Section II.B to read "within six months of the start of wafer production or three years from the effective date of the permit if the facility is in operation..." and change "the effective date of the permit" in the next sentence to "the start of wafer production." (Section II.B).

Response: The EPA has changed the wording of Section II.B to read "Microchip shall

commence a study **within six months of the start of wafer production or within three years of the effective date of the permit, whichever is sooner** to study the alternate use of process chemicals that don't contain fluoride as an active ingredient. A report on the feasibility of alternate chemical use shall be submitted to the Tribe's Environmental Protection Department within **six months of the commencement of the study**. The feasibility report shall be reviewed and approved by the Tribe's Environmental Protection Department prior to implementation." The due dates in the permit must be tied to a specific date for compliance tracking purposes, whereas the start of wafer production is an unknown data.

Potential discharge to City

34. Comment (Microchip): "Boiler blowdown" should be included in the list of potential waste streams. (Section I.E).

Response: Section I.E of the final permit has been modified to include the discharge of boiler blowdown to the City's collection system. EPA wants to emphasize that Microchip's NPDES permit does not allow the discharge per se, but only provides the public with the knowledge that this may happen in the future. Any future discharge to the City's collection system would be regulated by the City under its pretreatment program and ordinances.

General Comment on Permit

35. **Comment (Retherford):** We are not aware of the chemicals in Microchip's effluent but assume it can be dangerous and toxic to plant and animal life.

Response: The discharge of chemicals can be dangerous to both humans and aquatic life if not properly controlled and regulated. The NPDES permit reissued to Microchip Technology Inc. allows only those concentrations of pollutants that have been determined by EPA and the Puyallup Tribe to be protective of domestic, industrial and agricultural water supply, stock watering, fish and shellfish (including salmonids, crustaceans and

other shellfish, and other fish), wildlife habitat, ceremonial and religious water use, commerce, navigation, and primary and secondary recreation.

Mixing Zone Should not be Allowed

36. Comment (Citizens for a Healthy Bay): A mixing zone which allows the discharge of pollutants that exceed the state water quality standards into Commencement Bay is not in the spirit of the Clean Water Act (CWA). The objective of the CWA is to "restore and maintain the chemical, physical, and biological integrity of the nation's waters."Section 1251 of the CWA states that "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited", and that "it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985." Microchip Technology Inc. should be required to meet water quality standards at the end of the pipe. The Puyallup River has been placed on the 303(d) list of "impaired and threatened water bodies" by the Washington Department of Ecology for arsenic.

Response: Just as a point of clarification, because Microchip Technology Inc. discharges into the Puyallup River within the boundaries of the Puyallup Tribe of Indians reservation, the Tribe's federally approved water quality standards apply to the discharge. The Tribe's water quality standards are similar to the *Water Quality Standards for Surface Waters of the State of Washington* (Chapter 173-201A WAC) in that they allow for mixing zones, which are intended to allow a small area of the receiving water to provide dilution of the effluent. Water quality-based effluent limits with mixing zones are designed such that the water quality criteria are met at and beyond the boundaries of the mixing zone. Therefore the discharge from the Microchip facility will not result in a degradation of the water quality of Commencement Bay.

The final NPDES permit contains conditions that are consistent with the Puyallup Tribe's final 401 certification which states that 25% by volume mixing zones have been provided for ammonia, mercury, temperature and chlorine. The EPA agrees with the commenter that mixing zones are not appropriate for those parameters for which the receiving water is already impaired (i.e., arsenic). The proposed mixing zones for ammonia, mercury, temperature and chlorine have been retained in the final permit.

APPENDIX A - RESPONSE TO PUYALLUP TRIBE OF INDIANS SECTION 401 CERTIFICATION

The Puyallup Tribe of Indians has granted certification of NPDES permit WA0039578 under Section 401 of the Clean Water act, provided that certain conditions are met. This appendix outlines the conditions of the Section 401 certification, and how these conditions certification are incorporated into the final permit.

401 Certification Condition #1: A mixing zone pursuant to section 9 of the Tribe's Water Quality Standards is authorized for ammonia, total residual chlorine, mercury and temperature, *provided that* the permittee monitor annually during critical conditions at the edge of the mixing zone to demonstrate attainment of water quality criteria. A Quality Assurance Project Plan (QAPP) shall be submitted to the Tribe's Environmental Protection Department and EPA for review and approval prior to sampling. Development of the QAPP shall follow EPA guidelines.

Permit Implementation: The effluent limits (Table 1) in the final permit for ammonia, total residual chlorine, mercury and temperature are calculated using 25% by volume mixing zones. Surface water monitoring requirements are outlined in Section I.D. of the final permit. The permit requires annual monitoring at a location 302 feet downstream of the outfall, at the edge of the mixing zone, for total ammonia as N, temperature, total residual chlorine, and mercury (Table 2). Quality assurance is to be documented under the Quality Assurance Plan required in section II.A. of the final permit. Section II.A.1. requires the QAP to be submitted to the Tribe's environmental protection department within 90 days of permit issuance. Section II.A.3. requires that the QAP follow EPA guidelines.

401 Certification Condition #2: A copy of the Wastewater Treatment System Operating Plan shall be submitted to the Tribe's Environmental Protection Department. The Operating Plan shall include all plans identified in Permit WA-003957-8, Interim Startup and Operation Activities (ISUOA), Revision 3.0-October 2004, and Microchip Fab 3: Summary of Arsenic Analysis and Program; provided, in the event of a conflict between the operating plan and this certification, the specific requirements of this certification shall control.

Permit Implementation: Section III.E.1. of the final permit requires that the permittee prepare a Wastewater Treatment System Operating Plan (WWTSOP) as an umbrella document for the various plans required under this permit. All plans identified in this permit may be included as elements of the WWTSOP, rather than as separate stand-alone plans. The WWTSOP shall include an Operation and Maintenance Plan for the facility and be provided to the Tribe's Environmental Protection Department upon completion in accordance with II.E. EPA believes that the final permit includes all of the conditions

required by the Certification. The conditions in an NPDES permit always control in the event of a conflict with an operating plan, therefore the condition that the certification is controlling in the event of a conflict with the WWTSOP is not necessary.

401 Certification Condition #3: Batch Discharges – All procedures set forth in the Interim Startup and Operation Activities plan (Revision 3.0-October 2004 or as may be modified with approval of the Tribe) shall be followed while the Microchip facility is idle and/or during start-up operations.

Permit Implementation: This condition has been added to the final permit as Section III.E.6.

401 Certification Conditions #4: Batch discharges and non-process wastewater including, but not limited to, cooling tower and boiler blowdown waste streams, shall be prohibited from being discharged to the Puyallup River vis outfall 001. Maintenance of the tightline pending notification and authorization of the Tribe, however, shall be allowed. It is the Tribe's understanding that Microchip intends to discharge batch wastes and non-process waste streams to the City of Puyallup's sanitary sewer. This certification may be modified, revoked, or reissued at the discretion of the Tribe in the event the pending non-process wastewater discharge agreement between Microchip and the City of Puyallup is not approved by city officials or is amended.

Permit Implementation: Section I.A.1 of the permit has been modified to read**:**

"The permittee is authorized to discharge from outfall 001, subject to the restrictions set forth herein. This permit does not authorize the discharge of any waste streams, including spills and other unintentional or non-routine discharges of pollutants, that are not part of the normal operation of the facility as disclosed in the permit application, or any pollutants that are not ordinarily present in such waste streams. *Batch discharges and non-process wastewater including, but not limited to, cooling tower and boiler blowdown waste streams, shall be prohibited from being discharged to the Puyallup River via outfall 001. Maintenance of the tightline pending notification and authorization of the Tribe, however, shall be allowed.* Effluent limitations are maximum values unless otherwise noted.

401 Certification Condition #5: Per Microchip Fab 3: Summary of Arsenic Analysis and Program plan (October 2004), all known, available, and reasonable methods of prevention, control and treatment (AKART) shall be used to reduce arsenic concentrations of Microchip's wastewater prior to discharge into the Puyallup River. For purposes of this certification AKART shall include an arsenic pollution prevention and source control program, which includes:

1. Procuring commercially available non-process chemicals with the lowest possible concentrations of arsenic and evaluation of other potential sources of arsenic contributing to the wastewater.

2. Evaluation of chemical procurement polices, manufacturing processes, tightline and/or pollution control equipment for contributing arsenic to the wastewater (in addition to arsenic contributed in non-process flows); and

3. Implementation of available treatment technologies (adsorption) to reduce arsenic concentrations of wastewater prior to discharge to the Puyallup River. Microchip will provide certification that the chosen technology meets the best-known, available and reasonable standard at the time operations commence.

Permit Implementation: The AKART conditions have been added to the final permit as section III.E.5.

401 Certification Condition #6: The Tribe received funds to conduct an arsenic study in the Puyallup basin to address "natural background". This study was initiated in the spring of 2004. The results of the study are consistent with average monthly and maximum daily arsenic effluent limits of 0.68 ug/L and .8 ug/L, respectively. The final effluent limits for arsenic will become effective upon permit reissuance. Effluent monitoring for permit compliance shall be set at 5.0 ug/L and shall occur at least monthly, reporting results using Standard Method 200.8. Additional low-level arsenic sampling shall be conducted by Microchip at least monthly, with results reported directly to the Tribe using Standard Method 6020. The Tribe reserves the right to modify, revoke, or reissue this certification based on the results of the study discussed herein.

Permit Implementation: Footnotes 2 and 3 to Table 1 - Effluent Limits and Monitoring Requirements have been revised to incorporate these conditions.

401 Certification Condition #7: Transfer – Microchip shall notify the Tribe's Environmental Protection Department at least 30 days in advance of the proposed transfer date. If the permit transferee does not confirm its commitment to comply with the provisions of the permit and 401 certification and certify the quality and quantity (comparably) of waste streams and waste products discharged to the Puyallup River, this certification may be modified, revoked or re-issued at the discretion of the Tribe.

Permit Implementation: The provisions for transfer of permits are included as section IV.K. Section IV.K.1. requires that the current permittee (Microchip) notify EPA and the Tribe's Environmental Protection Department at least 30 days in advance of the proposed transfer date. EPA believes that, by agreeing to the transfer, a new permittee confirms its

commitment to comply with the conditions of the permit and the 401 certification. Therefore no change will be made the final permit regarding transfers.

APPENDIX B: REVISED EFFLUENT LIMIT CALCULATIONS FOR AMMONIA

Step 1. Determine the appropriate criteria

1A. Determine the uses

The Puyallup River is protected by the Puyallup Tribe for the following uses:

domestic, industrial and agricultural water supply, stock watering, fish and shellfish (including salmonids, crustaceans and other shellfish, and other fish), wildlife habitat, ceremonial and religious water use, commerce, navigation, and primary and secondary recreation.

1B. Determine the most stringent criterion to protect the uses

The most stringent criterion associated with these uses is for protection of salmonid spawning. The criteria for ammonia are based on temperature and pH (see Appendix C, section IV.D of the Fact Sheet). Using reasonable worst-case assumptions of 7.7 standard units for pH and 15.5°C for temperature, the acute criterion (CMC) and chronic criterion (CCC) corresponding to this level of protection are 9.28 mg/l as a one-hour average and 2.04 mg/l as a four-day average, respectively.

Step 2. Determine whether there is "reasonable potential" to exceed the criteria

2A. Determine the "reasonable potential" multiplier

The "reasonable potential" multiplier is based on the coefficient of variation (CV) of the data and the number of data points. In this case, after removing the outliers, there are 45 data points, with a CV of 1.57. Using the equations in section 3.3.2. of the Technical Support Document (TSD), the reasonable potential multiplier (RPM) is calculated as follows:

$$_{PN} = (1 - \text{confidence level})^{1/n}$$

where,

$_{pN}$ = the percentile represented by the highest concentration
n = the number of samples

$$_{pN} = (1\text{-}0.99)^{1/45}$$
$$_{pN} = 0\ .903$$

This means that the largest value in the data set is greater than the 90th percentile.

Next, the ratio of the 99th percentile to the 90th percentile is calculated, based on the equation:

$C_p = \exp(z. - 0.5\sigma^2)$

where,

$\sigma^2 = \ln(CV^2 + 1) = 1.24$
CV = coefficient of variation = 1.57
z = normal distribution value
= 2.326 for the 99th percentile
= 1.297 for the 90th percentile

$C_{99} = \exp(2.326 \times 1.11 - 0.5 \times 1.24)$

$= 7.18$

$C_{90} = \exp(1.297 \times 1.11 - 0.5 \times 1.24)$

$= 2.28$

$RPM = C_{99}/C_{90}$
$= 7.18/2.28$

RPM = 3.15

2B. Calculate the concentration of the pollutant at the edge of the mixing zone

There is reasonable potential to exceed criteria if the maximum projected concentration of the pollutant at the edge of the mixing zone exceeds the criterion. The maximum projected concentration is calculated from the following equation:

$$C_d = \frac{C_e - C_u}{D} + C_u$$

where,

C_d = receiving water concentration at the edge of the mixing zone
C_e = maximum projected effluent concentration
= maximum reported effluent concentration × reasonable potential multiplier = 7.9 × 3.15 = 24.9 mg/L
C_u = upstream concentration of pollutant = 0.05 mg/l
= 95th percentile of ammonia concentrations at WOE station #10A070, October 1992 - September 2002
D = dilution factor (1.8 for acute, 11.5 for chronic)

For the acute criterion,

$$C_d = \frac{24.9 - 0.05}{1.8} + 0.05$$

C_d = 13.9 mg/l

For the chronic criterion,

$$C_d = \frac{24.9 - 0.05}{11.5} + 0.05$$

C_d = 2.2 mg/l

The concentrations at the edges of the acute and chronic mixing zones are greater than the criteria (9.28 mg/l acute and 2.04 mg/l chronic), therefore water quality-based limits must be included in the permit.

Step 3. Calculate the wasteload allocations

Wasteload allocations (WLA) are calculated using the same mass balance equation used to calculate the concentration of the pollutant at the edge of the mixing zone. However, C_d becomes the acute or chronic criterion and C_e is replaced by the acute or chronic WLA. The equation is rearranged to solve for the WLA, becoming:

$$WLA = D \times (CAC - C_u) + C_u$$

For the acute criterion

$$WLA = 1.8 \times (9.28 - 0.05) + 0.05$$

WLA = 16.7 mg/l

For the chronic criterion

$$WLA = 11.5 \times (2.043 - 0.05) + 0.05$$

WLA = 23.0 mg/l

The WLA are converted to long-term average concentrations, using the following equations from EPA's *Technical Support Document for Water Quality-based Toxics Control* (TSD):

$$LTA_A = WLA \times \exp(0.5\sigma^2 - z.)$$
$$LTA_c = WLA \times \exp(0.5\sigma_4^2 - z\sigma_4)$$

where,

σ^2 = $\ln(CV^2 + 1)$
σ^2 = 1.243
σ_4^2 = $\ln(CV^2/4 + 1) = 0.480$
z = 2.326 for 99th percentile probability basis

LTA_A = 16.7 mg/l × exp(0.5 × 1.243 - 2.326 × 1.115)
LTA_A = 2.32 mg/l

LTA_c = 23.0 mg/l × exp(0.5 × 0.48 - 2.326 × 0.693)
LTA_c = 5.83 mg/l

The LTAs are compared and the more stringent is used to develop the daily maximum and monthly average permit limits. In this case, the acute LTA is more stringent.

Step 4. Derive the maximum daily (MDL) and average monthly (AML) permit limits

Using the TSD equations, the MDL and AML permit limits are calculated as follows:

$$MDL = LTA \times \exp(z. - 0.5\sigma^2)$$

where:

z = 2.326 for 99th percentile probability basis

MDL= 2.32 mg/l × exp(2.326 × 1.115 - 0.5 × 1.243)

MDL= 16.7 mg/l

$$AML = LTA \times \exp(z\sigma_n - 0.5\sigma_n^2)$$

where:

$\sigma_n^2 = \ln(CV^2/n + 1)$

z = 1.645 for 95th percentile probability basis
n = number of sampling events required per month (4)

AML = 2.32 mg/l × exp(1.645 × 0 .693 - 0.5 × 0.480)

AML= 5.7 mg/l

A discharge of ammonia at the MDL concentration at the permitted flow rate of 1.88 mgd results in a daily loading of 262 lb/day, which is greater than the facility's wasteload allocation of 240 lb/day from the TMDL. Therefore, the permit shall require a maximum daily ammonia concentration limit of 240 lb/day ÷ (1.88 mgd × 8.34) = 15.3 mg/L, where 8.34 is a units conversion factor.

APPENDIX C: ARSENIC

Effluent versus upstream concentrations of arsenic

The following table summarizes the available data from the monitoring station in the Puyallup River at Meridian (this station is upstream of Microchip's outfall) and the effluent data. The data demonstrates that the arsenic concentrations in the effluent are on average 9 times greater than found upstream of the outfall.

Comparison of total arsenic upstream of outfall and from outfall 001 in µg/L			
Date	**Effluent**	**Date**	**Puyallup River**
06/01/01	7.32	6/18/01	0.83
08/01/01	9.67	8/22/01	1.1
09/01/01	10.74	9/19/01	0.85
10/01/01	8.95	10/30/01	0.63
12/01/01	3.15	12/11/01	0.67
03/01/02	2.16	03/26/02	0.47

Total recoverable versus total inorganic arsenic

The following table summarizes the available data from Microchips DMRs from 2001 through 2003 to evaluate how much of the arsenic in the effluent is in the total versus inorganic form. The inorganic form is on average 52% (about half) of the total form.

Comparison of total arsenic to inorganic arsenic in µg/L		
Date	**Total Recoverable**	**Total Inorganic**
01/01/01	1.87	0.89
02/01/01	2.89	1.13
03/01/01	5.2	3.85
04/01/01	2.81	2.26
05/01/01	2.3	1.61
06/01/01	7.32	2.29

08/01/01	9.67	1.17
09/01/01	10.74	1.1
10/01/01	8.95	1.47
12/01/01	3.15	1.11
03/01/02	2.16	0.67
12/01/02	2.98	1.49
02/01/03	3.3	1.03
04/01/03	2.5	1.0
06/01/03	7.14	5.33
09/01/03	1.98	2.71
10/01/03	2.88	2.8

Reasonable Potential and Effluent Limit Calculations

Step 1. Determine the appropriate criteria

1A. Determine the uses

The portion of the Puyallup River to which the Microchip facility discharges is designated as Class A water by the Puyallup Tribe. Class A waters are protected for the following uses: domestic, industrial and agricultural water supply, stock watering, fish and shellfish (including salmonids, crustaceans and other shellfish, and other fish), wildlife habitat, ceremonial and religious water use, commerce, navigation, and primary and secondary recreation.

1B. Determine the most stringent criterion to protect the uses

The most stringent criterion associated with these uses is for the protection of human health. The following criteria have been adopted by the Tribe for freshwater (see Section 5 - Toxic substances, of the Tribe's water quality standards):

Aquatic Life		Human Health
Chronic	Acute	Class A
360 µg/L (total)	190 µg/L (total)	0.018 µg/L (inorganic)

However, Section 8 (2) -Antidegradation, of the Tribe's water quality standards allow that:

> "Whenever the natural conditions of said waters are of a lower quality than the criteria assigned, the natural conditions shall constitute the water quality criteria."

The anti-degradation standard can be used when sufficient data is available to determine natural background, otherwise the standard does not apply and the reasonable potential calculations and effluent limits must be based on the tribe's class A human health criteria (0.018 µg/L). The Puyallup Tribe is currently conducting a study to ascertain the natural background concentration of arsenic in the Puyallup River. In the interim, EPA has utilized the available data to determine the natural background concentration.

The EPA reviewed the data upstream of Microchip's outfall gathered by the United States Geologic Survey (USGS) and found it to be not helpful. Most of the sites measured only dissolved arsenic. Only one of the upstream stations measured total recoverable arsenic (USGS 12096500, Alderton) but only had one sample (January 25, 1984).

The best upstream arsenic data is found in the Washington State Department of Ecology report *Results and Recommendations from Monitoring Arsenic Levels in 303(d) Listed Rivers in Washington*. However, the data was not available in the inorganic form so sixteen total recoverable sample were used to calculate an average value of 0.68 µg/L. The samples were collected from the Puyallup River above the outfall (12 from the Meridian Street bridge, two from above Carbon River, and two from above Electron) between April 2001 and June 2002. The "average" of the data results in slightly larger values than the median or the geometric mean. An average value is more realistic than a 95^{th} percentile value because it represents long term exposure and human health criteria is based on long term exposure (unlike aquatic life criterion). It is reasonable to use total recoverable data (rather than inorganic) because the WDOE study states that total inorganic arsenic is often the major form of arsenic in surface waters (page 3, WDOE 2002). The study further states that total inorganic arsenic is typically $\geq$75% of total recoverable (page 14, WOE 2002). Based on the results of the Ecology study the 0.68 µg/L value is similar to concentrations of arsenic in other Washington rivers with no apparent anthropogenic sources of contamination. Because the 0.68 µg/L value is below the aquatic life criterion but above the human health criterion, EPA has used the value as if it were a human health criterion.

Step 2. Determine if there is "reasonable potential" to exceed the criteria

In order to determine if the effluent has or has the potential to exceed the criteria, EPA compares the maximum expected effluent concentration with the criteria.

2A. Determine the reasonable potential multiplier

The reasonable potential multiplier is based on the coefficient of variation (CV) of the data and the number of data points. EPA used the following 48 total recoverable data points with a CV of 1.06.

02/28/1998	0.53
03/31/1998	0.46
04/30/1998	0.7
05/31/1998	0.7
06/30/1998	0.7
07/31/1998	0.7
08/31/1998	0.7
09/30/1998	0.528
10/31/1998	1.2
11/30/1998	0
12/31/1998	0
01/31/1999	0.53
02/28/1999	1.25
03/31/1999	0.8
04/30/1999	0.69
05/31/1999	0.48
06/30/1999	0.48
07/31/1999	0.89
08/31/1999	0.673
09/30/1999	4.9
10/31/1999	0.49
11/30/1999	7
12/31/1999	8.6
01/31/2000	0.48
03/31/2000	1.5
04/30/2000	2.4
05/30/2000	7.8
06/30/2000	7.8
09/30/2000	4.56
11/30/2000	1.84
12/31/2000	1.54
01/31/2001	1.87
02/28/2001	2.89

03/31/2001	5.2
04/30/2001	2.81
05/31/2001	2.3
06/30/2001	7.32
08/31/2001	9.67
09/30/2001	**10.74**
10/31/2001	8.95
12/31/2001	3.15
03/31/2002	2.16
12/31/2002	1.49
04/30/2003	1
06/30/2003	7.14
09/30/2003	1.98
10/30/2003	2.88
02/26/2004	1.2

Using the equations in section 3.3.2 of the Technical Support Document (TSD), the reasonable potential multiplier is calculated as follows:

$p_n = (1\text{-confidence level})^{1/n}$

where,
p_n = the percentile represented by the highest concentration
n = the number of samples = 48

$p_n = (1 - 0.99)^{1/48}$
$p_n = 0.91$

This means that the largest value in the data set is greater than the 91st percentile.

Next, the ratio of the 99th percentile to the 91st percentile is calculated based on the equation:

$C_p = \exp(z\sigma - 0.5\sigma^2)$

where,
σ^2 = $\ln(CV^2 + 1) = 0.753$
CV = coefficient of variation = 1.06
z = normal distribution value
= 2.326 for the 99th percentile
= 1.34 for the 91th percentile

RPM = C_{99}/C_{91} = 5.16/2.19 = 2.35

2B. Calculate the maximum expected effluent concentration

$C_e = RPM \times C_{max} = 2.35 \times 10.74$ µg/L (09/30/01) = 25.3 µg/L

2C. Calculate the concentration of the pollutant at the edge of the mixing zone

$C_d = \frac{C_e - C_u}{D} + C_u$ This equation is used for aquatic life since the new natural background value is less than aquatic life criteria

$C_d = C_e$ This equation is used for human health since a mixing zone (i.e., dilution) is not available. The new natural background value (0.68 µg/L) is not less than the new human health criteria (0.68 µg/L)

where,
C_d = receiving water concentration at the edge of the mixing zone
C_e = maximum projected effluent concentration (25.3 µg/L)
C_u = upstream concentration of pollutant
For aquatic life = 95th percentile = 1.13 µg/L
D = Dilution factor (1.8 for acute, 11.5 for chronic, no dilution available for human health because the upstream concentration is equal to the criterion)

$C_{d\text{-acute}}$ = (25.3 µg/L - 1.13 µg/L)/1.8 + 1.13 µg/L = 14.4 µg/L

Since 14.4 µg/L is less than the acute aquatic life criterion of 360 µg/L, there is no reasonable potential for the discharge to cause a violation of the acute aquatic life criterion.

$C_{d\text{-chronic}}$ = (25.3 µg/L - 1.13 µg/L)/11.5 + 1.13 µg/L = 3.2 µg/L

Since 3.2 µg/L is less than the chronic aquatic life criterion of 190 µg/L, there is no reasonable potential for the discharge to cause a violation of the chronic aquatic life criterion.

$C_{d\text{-health}}$ = 25.3 µg/L

Since 25.3 µg/L is greater than the estimated background concentration of 0.68 µg/L, there is reasonable potential for the discharge to cause a violation of the human health criterion, therefore an effluent limit is required.

For illustrative purposes if EPA conducted the above RP analysis only using the three effluent data points since September 2003 (1.98 ug/L, 2.88 ug/L, and 1.2 ug/L). Because there are less than 10 data points a CV of 0.6 was used (as recommended by the TSD). The RP multiplier in this case is 5.6 (See Table 3-1 of the TSD). The maximum expected effluent concentration is therefore 5.6 × 2.88 = 16.1 µg/L. This is greater than the natural background (human health) criterion of 0.68 µg/L and therefore effluent limits are required.

Step 3. Calculate the permit limits

3A. Calculate the wasteload allocations

Wasteload allocations (WLA) are calculated using the same mass balance equation used to calculate the concentration of the pollutant at the edge of the mixing zone (when available). A mixing zone (i.e., dilution) is not available when calculating a WLA for the protection of human heath because the background concentrations are not less than the criteria. In this case, we substitute the criterion for C_d, and the calculated C_e is the WLA. The acute criteria is CMC and the chronic criterion is CCC.

WLA_{acute} $= D \times (CMC - C_u) + C_u$
$= 1.8 \times (360\ \mu g/L - 1.13\ \mu g/L) + 1.13\ \mu g/L$
$= 647\ \mu g/L$

$WLA_{chronic}$ $= D \times (CCC - C_u) + C_u$
$= 11.5 \times (190 \mu g/L - 1.13 \mu g/L) + 1.13\ \mu g/L$
$= 2173\ \mu g/L$

WLA_{HH} $= D \times (\text{human health criteria} - C_u) + Cu$
$= 1 \times (0.68\ \mu g/L - 0.68\ \mu g/L) + 0.68\ \mu g/L$
$= 0.68\ \mu g/L$

3B. Calculate the long term average (LTA) concentrations

LTA_{acute} $= WLA_{acute} \times \exp(0.5\sigma^2 - z\sigma)$
$LTA_{chronic}$ $= WLA_{chronic} \times \exp(0.5\sigma_4^2 - z\sigma_4)$

Where
σ^2 $= \ln(CV^2 + 1) = 0.763$
σ_4^2 $= \ln(CV^2/4 + 1) = 0.2517$
z $= 2.326$ for 99th percentile probability basis

LTA_{acute} $= 647\ \mu g/L \times \exp(0.5 \times 0.763 - 2.326 \times .874) = 124\ \mu g/L$
$LTA_{chronic}$ $= 2173\ \mu g/L \times \exp(0.5 \times 0.252 - 2.326 \times 0.502) = 767\ \mu g/L$

The LTAs are compared and the more stringent is used when developing the daily maximum and monthly average permit limits. In this case, for aquatic life, the acute LTA is more stringent.

3B. Calculate the maximum daily limit (MDL) and the average monthly limit (AML) from the most stringent LTA.

$MDL = LTA \times \exp(z\sigma - 0.5\sigma^2)$

where
z = 2.326 for 99th percentile probability basis

MDL = 124 µg/L × exp(2.326 × 0.874 - 0.5 × 0.763)
MDL = 647 µg/L

$AML = LTA \times \exp(z\sigma_n - 0.5\sigma_n^2)$

where
z = 1.645 for 95th percentile probability basis
σ_n^2 = $\ln(CV^2/n + 1)$
n = number of sampling events per month (4)

AML = 124 µg/L × exp(1.645 × 0.502 - 0.5 × 0.252)
AML = 250 µg/L

The human health criterion is more stringent than the aquatic life criteria. Chapter 5.4.4 of the TSD explains how to develop effluent limits based on human health criteria. The TSD recommends setting the AML equal to the human health wasteload allocation. In general, human health criteria are based on long term average exposure. The natural background value is similar to the concentration of arsenic found in Washington rivers with no apparent anthropogenic contamination. The TSD recommends calculating the MDL from the AML based on effluent variability, and the number of samples taken per month.

Therefore:
AML = 0.68 µg/L

$$\frac{MDL}{AML} = \frac{\exp(z_m\sigma - 0.5\sigma^2)}{\exp(z_a\sigma_n - 0.5\sigma_n^2)}$$

where
CV = Coefficient of variation = 1.07
σ^2 = $\ln(CV^2 + 1)$ = 0.763
σ_n^2 = $\ln(CV^2/n + 1)$ = 0.252

n = number of sampling events per month (4)
z_m = 2.326 for 99th percentile probability basis
z_a = 1.645 for 95th percentile probability basis

MDL = 1.8 µg/L

Because the AML and MDL developed using the human health criteria are more conservative than those developed using the aquatic life criteria they have been included in the final permit.